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## THE BACTERIOLOGY OF THE SKIN LESIONS IN SMALLPOX

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Twenty cases of smallpox in a mild epidemic in Chicago in the winter 1921-22 have been studied through the cooperation of Dr. A. Hoyne of the Chicago Health Department. There were 3 severe confluent cases that terminated fatally, 6 were of a mild type with only a few discrete lesions, and the remaining 11 might be classed as of a severe discrete type because of the great number of lesions and severity of the symptoms.

The contents of the lesions, when in the vesicular and pustular stages, were used for cultures and smears. Blood cultures were available in only a few of the cases. The method of procedure was as follows: After sponging the lesion with alcohol, sterile pipets were inserted and the contents withdrawn. Smears were made of a portion and the remainder transferred to a nutrient broth containing 0.5% dextrose, and incubated under aerobic and anaerobic conditions for 24 hours. The growth was then plated by surface inoculation on sheep blood-agar plates, containing 1 part of citrated sheep blood to 10 parts of plain agar.

As shown in table 1, streptococci were obtained by cultures from the lesions in 5 of the 20 cases. Hemolytic streptococci were present in 2 and nonhemolytic streptococci in 1 of the 3 fatal cases. Staphylococcus albus was found in combination with streptococci in 2 cases and alone in 7 cases. Once a hemolytic staphylococcus was present in combination with a streptococcus. Of the 17 patients that recovered, streptococci were obtained from the lesions in 2 instances or in less than 12%. No streptococci were obtained during the vesicular stage.

Three of the strains of streptococci were of the hemolytic and 2 of the viridans type. The strains of hemolytic streptococci from the lesions, as well as the hemolytic streptococci from the throats of the corresponding patients, were gram-positive and produced a wide zone of hemolysis (3 to 5 mm. in width) on sheep blood-agar plates in 24 hours. They fermented dextrose, maltose, lactose, and salicin but did not ferment mannite inulin, dulcitol or raffinose and therefore

would be classed as *Streptococcus pyogenes* (Holman<sup>1</sup>). The 2 viridans strains were gram-positive, bile insoluble and of the streptococcus mitis group. Rabbits were injected intravenously with 2 of the strains of hemolytic streptococci. Suspensions of a 24 hour growth on a blood-agar slant were made in normal salt solution and heated for 30 minutes at 56 C. The first injection was  $\frac{1}{4}$  of a slant and the dose was doubled with each succeeding injection at intervals of 7 days. Four days after the fourth injection the serum usually gave a satisfactory agglutinin titer. Daily repeated subcultures in broth containing 1% dibasic sodium phosphate and 0.5% dextrose was the means of overcoming the tendency of the cultures to spontaneous agglutination. The antiserum for the streptococci from the lesions of case 2 agglutinated suspensions of hemolytic streptococci from the throat in acute tonsillitis as well as from smallpox lesions, while the antiserum for the streptococcus from the lesions of case 14 contained agglutinins for that strain only.

It is well known that streptococci are found in the blood in fatal cases of smallpox. In 40 necropsies, Perkins and Pay<sup>2</sup> found them in the heart blood and viscera of 95%. Their observations were made before the streptococci had been separated into hemolytic and non-hemolytic groups. Studying typical variolous lesions at all stages they found streptococci in only 4 of 30 cases while De Wael and Sugg<sup>3</sup> found streptococci constantly in smallpox pustules.

If the rôle of streptococci is that of a secondary invader only, one would expect to find them in the later stages of the disease, after the resistance of the patient has been lowered. Thus Perkins and Pay<sup>2</sup> found them in the skin lesions only after the eighth day. Invasion may occur earlier than this, however, for Kempton and Parsons<sup>4</sup> report a case of purpura variolosa in which hemolytic streptococci were obtained from the blood 36 hours after the onset of symptoms and before the appearance of the eruption. The one case of purpura variolosa in my series was not observed before the eighth day of the disease when streptococci were abundant in the lesions.

#### SUMMARY

Hemolytic streptococci occurred in the pustules of smallpox in 3 and nonhemolytic in 2 of 20 cases. Staphylococci were found in

<sup>1</sup> Jour. Med. Res., 1916, 34, p. 377.

<sup>2</sup> Jour. Med. Res., 1903, 10, p. 180.

<sup>3</sup> Arch. Int. de Pharm. et de Therap., 1903, 12, p. 105.

<sup>4</sup> Arch. Int. Med., 1920, 26, p. 594.

seven cases. Death took place in 3 cases and streptococci were found in the skin lesions of all 3. The agglutinin test indicated that the hemolytic streptococci found in the skin lesions belonged to different groups.

TABLE 1  
SUMMARY OF RESULTS IN TWENTY CASES OF SMALLPOX

Cases	Type of Disease	Day of Disease	Lesions Cultured	Results	
				Smears	Cultures
1	Mild, discrete.....	7	Vesicle.....	0	0
		10	Pustule.....	0	0
		17	Dried pustule.....	0	0
2	Confluent, fatal....	8	Pustule.....	Streptococci	Hemolytic streptococci
		11	Pustule.....	Streptococci	Hemolytic streptococci
3	Confluent, fatal....	8	Pustule.....	Streptococci and staphylococci	Hemolytic streptococci and staphylococci
4	Severe, confluent....	30	Secondary abscess of foot	0	0
5	Mild, discrete.....	10	Pustule.....	0	0
		15	Dried pustule.....	0	0
6	Severe, discrete.....	8	Vesicle.....	0	0
		10	Pustule.....	Streptococci	Hemolytic streptococci and staphylococci albus
7	Severe, discrete.....	8	Vesicle.....	0	0
		10	Pustule.....	0	0
		12	Pustule.....	Staphylococci	Staphylococcus albus and diphtheroid bacilli
8	Severe, discrete.....	8	Late vesicle.....	0	0
		10	Pustule.....	0	0
		12	Pustule.....	0	Staphylococcus albus
9	Mild, discrete.....	6	Vesicle.....	0	0
10	Severe, semiconfluent	9	Pustule.....	0	0
		7	Vesicle.....	0	0
11	Severe, discrete.....	9	Pustule.....	0	Staphylococci
		6	Vesicle.....	0	Staphylococcus albus
		8	Pustule.....	Staphylococci	Staphylococcus albus
12	Mild, discrete.....	8	Pustule.....	0	0
13	Mild, discrete.....	6	Vesicle.....	0	Staphylococcus aureus
		8	Pustule.....	Staphylococci	Staphylococcus albus
14	Very severe, confluent of face, discrete of body	7	Vesicle.....	0	0
		9	Pustule.....	Streptococci	Hemolytic streptococci
15	Mild, discrete.....	9	Blood culture.....	—	0
		7	Vesicle.....	0	0
		9	Pustule.....	Staphylococci	Staphylococcus albus
16	Moderate, discrete..	6	Vesicle.....	0	0
17	Moderate, discrete..	9	Pustule.....	0	0
		7	Pustule.....	0	0
18	Very mild.....	9	Pustule.....	0	0
		8	Pustule.....	0	0
19	Severe, discrete.....	10	Pustule.....	0	0
		7	Vesicle.....	0	0
		9	Pustule.....	0	Staphylococcus albus
20	Hemorrhagic pustulous, fatal	8	Pustule.....	Streptococci and staphylococci	Streptococcus viridans and hemolytic staphylococci